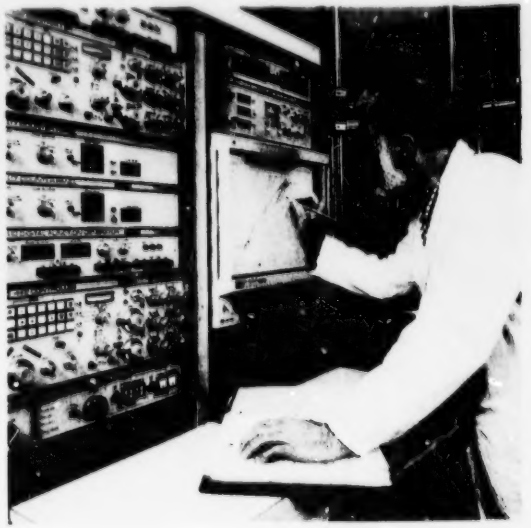
1983 Annual Report

ONTARIO**RESEARCH** "If one word could sum up Canada's biggest need for economic growth, it would be PRODUCTIVITY..."



85-0095/

Highlights

W. Paul Midghall became president in October.

ORF assumed total technical and administrative responsibility for Energy Bus program.

Asbestos fibre concentrations in water were studied for the U.S. Environmental Protection Agency.

New, high technology division of Blue Mountain Pottery was assisted with initial advanced electronic ceramics project.

Full-scale fire tests were conducted for VIA Rail Canada Inc.

Equipment for evaluating drilling muds was designed for Technifluids of Calgary.

Experimental analysis on the elbow joint section of Spar Aerospace Limited's manipulator arm were conducted.

ORF evaluated asbestos fibre quality and recovery from 12-inch drill core samples for Watts, Griffis & McOuat Limited.

Front cover, left to right:
Walter Malis at the Instron machine.
Liz Shaubel records test results in the Textiles Laboratory.
Bill Prendergast at work in Materials Properties Testing.

This page:
ORF President W. Paul Midghall.

Opposite page, left to right:
Chairman of the Board, Dr. Donald Chisholm.
Meeting of members of the Ontario Research Foundation Board of Governors.

Contents

A Note from the Chairman	1
Comments from the President	2
Energy	4
Environment	6
Materials	8
Products & Processes	11
Resources	15
Board Members & Officers	17
Financial Statements	19
1983 Papers	25
Some of our clients	26
Assistance to outside organizations	27

A note from the Chairman

Ontario Research Foundation appointed a new President in 1983. W. Paul Midghall, B.Eng., M.Sc. assumed the duties of this office in mid-October. Before joining Ontario Research, Mr. Midghall was President and Managing Director of Norton Canada Inc. We feel fortunate in having secured his services and look forward to his leadership in the coming years.

Mr. Midghall replaced W.R. Stadelman, ORF President for the past eighteen years. During Mr. Stadelman's presidency, the client base of Ontario Research grew from 300 to over 2,000 per year. The Board of Governors extends their thanks to Bill Stadelman for his long record of effective service to ORF.

The coming year will certainly be filled with increased challenges and opportunities for this organization. As most of us know, Ontario, along with the rest of Canada, has seriously declined in terms of industrial performance. Ontario Research must find ways to help redress this technological deficit if it is to fulfill its basic purpose of providing the Province with efficient, practical R&D. As Executive Vice-President, Technology and Innovation at Northern Telecom, I know how difficult the search for useful technologies can be. As Chairman of the Board of Governors of ORF, I am gratified that Mr. Midghall's remarks come to grips with several aspects of this problem.

Canada's current dilemma can only be solved with sound investment in industrial research and development. In 1982, our country was the sixth largest producer of goods in the world. Today, we have slipped to eleventh place. Our productivity improvement rate is one of the lowest of all developed nations. More and more of the goods and services we consume are imported – and so is more than 90% of the technology we are using.

Like it or not, we are in danger of losing a satisfying place in the future. The standard of living to which we have become accustomed may not be passed on to our children – unless we learn how to compete more successfully.

With more effective, widespread use of R&D, it can be done. Only countries that improve their technologies can hope to improve their economies as well as their trading positions in world markets. When you consider that about 30% of our gross national product depends on international trade, the need to discover and utilize competitive technical innovations becomes an imperative for Canada.

Because we are a nation of small manufacturers, many of our producers do not believe they can wage a successful battle against world competition. We must make them aware that some of the means for developing world-class technologies for industries of all sizes are already in place.

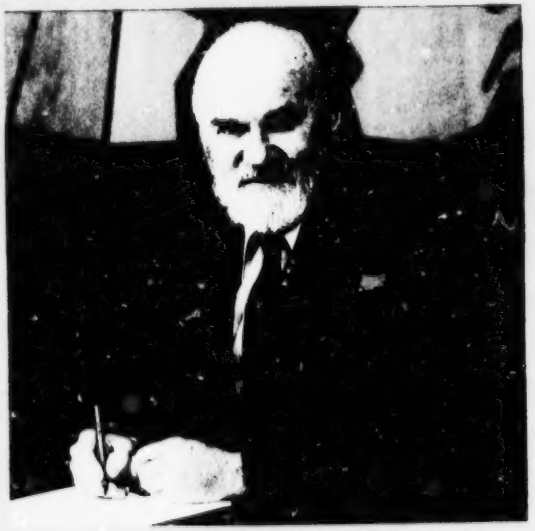
Canadian organizations such as Ontario Research Foundation are specially geared to help smaller companies improve their productivity in a number of ways. Essential R&D services performed by a high quality staff – for enhanced materials, more efficient processes, new products, new applications, and improved use of energy – are readily available at quite reasonable prices.

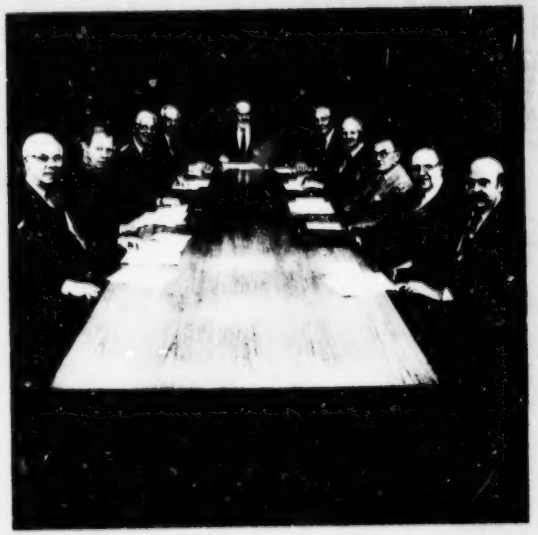
There are also sources of financial help. Both the Federal and Provincial Governments offer a number of incentives to companies wishing to improve their technological status. These range from partial funding of R&D services and start-up costs to direct tax incentives. At Ontario Research, we make a point of showing manufacturers how they can take advantage of these benefits.

All this and more is available to Canadian producers – particularly the smaller ones – who decide to meet dwindling profits or markets with R&D. Taking this step must become an instinctive first reaction for all Canadian manufacturers. Otherwise, our country may not win the most important economic battle of its life. The challenge is very real. Both the Management of ORF and its Board of Governors intend to extend themselves to the utmost to meet it.

Donald Chisholm

Dr. D.A. Chisholm





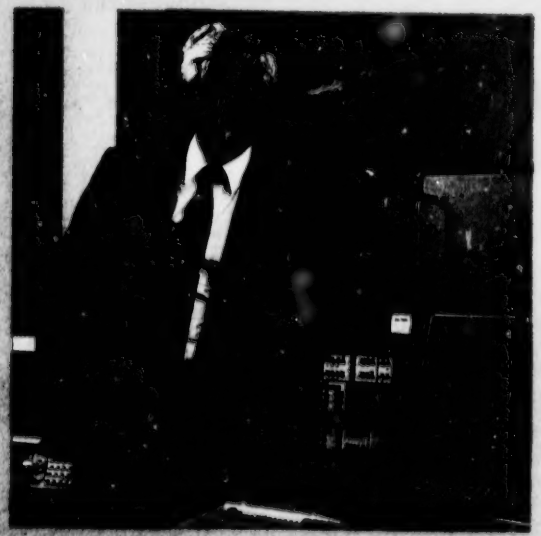
Comments from the President

Ontario Research Foundation has entered a new era. In becoming president of ORF, I have accepted the Board of Governors' call for renewed vigour and determination in meeting the urgency in Ontario's need for more effective industrial R&D. There are new challenges – within and without.

At this time I want to thank former president Bill Stadelman for his valuable help during my early weeks in office, and for his legacy of the very high standard of client service which ORF provides.

Under his guidance, Ontario Research has weathered the recent deep recession quite successfully. Although there have been cutbacks and organizational changes, we remain a solid entity, ready for new advances.

Timely action on the part of management at all levels of our organization has enabled us to maintain our 1983 budget close to the original forecast. This is truly commendable, considering the rather dismal economic climate that prevailed for most of the year. The results put us in an excellent position to pursue significant increases in revenue and a break-even budget in 1984.



To deal more effectively with both existing and new avenues of superior technology, development and innovation, twenty-five Business/Technical Centres are now operative at ORF. Each of these groups will be responsible for developing an annual business plan which will anticipate and meet all operating parameters. Sophisticated new management systems at Ontario Research will enable these centres to keep accurate progress statements on each of their projects.

In this age of high government deficits and low industrial profitability, we are determined to carry our full share of the load... to pay our way today as we produce opportunities for tomorrow. We will invest any surplus income back into our product... industrial research and development. It is one of the most-needed and most valuable resources in Ontario today.

In keeping with this policy, management at ORF is developing long-range strategic plans which will address the key issues involved. We have already begun the process of re-emphasizing many of our facilities in terms of the new role we must play in helping to rebuild the technological base of the Province. We are also in the preliminary stages of developing a series of new thrusts into the R&D marketplace. As Canada's largest independent R&D organization, co-founded and capitally supported by the Ontario Government and Ontario Industry, ORF has several vital functions to perform in the re-industrialization of the Province. The following outlines some of our early planning and thinking in this respect.

One major thrust would apply to advanced industrial materials and their commercial applications. Here is a field that desperately requires development in Canada. For example, advanced ceramics and composites are now being used to produce a variety of OEM items for Japanese cars – including significant engine parts. At present, all replacements made from these materials must come from Japan. Our metalworking plants must also acquire this new technology to create a host of new jobs. Ontario Research intends to develop a capacity which would provide our industries with a first-hand understanding of the production and formation processes of some of these critical new materials. Industries would also be able to develop new commercial applications at ORF and test out small production runs. Ontario Research already has extensive experience and facilities in the materials R&D area. This new direction would extend one of our well-established strengths and would fill a gap in Canada's need for materials.

If one word could sum up our biggest need for economic growth, it would be PRODUCTIVITY. A major factor in achieving significant increases in this area is the calibre of engineering applied in the plant. For this reason, Computer-Aided Engineering is another field where we intend to broaden our client service capability. We want to further develop our ability to give small and medium-sized manufacturers the opportunity of designing their own products and processes with fully computerized assistance. Their technical teams would be able to "live-in" at ORF and make confidential use of our highly advanced engineering equipment. We feel strongly that Ontario Research must keep current with all the fast evolving "hi tech" tools of technology and productivity improvement. Only then can we aid the threatened medium-sized manufacturer to fully meet the new world competition of the '80's.

Of course, increasing productivity depends on many factors besides advanced engineering. These include such things as improved plant layout, better production standards, having the right skills in the right places, quality control enhancement, and many others. Some companies with low levels of technology will want to begin their productivity programs by learning and applying "Quality Circle" techniques. Others have already gone through several stages of self-improvement and are now in a position to utilize the more sophisticated benefits of Computer-Aided Engineering for process and product design. We want to offer all industries the means of making intensive, step-by-step reviews and revisions of each phase of their technical operations. Perhaps we will call it ORF Productivity Counselling – a way for

Opposite page:
Paul Midghall with new Computer Aided Engineering equipment.

This page:
Brigitte Licht briefs Paul Midghall on the ITCA project.

Canadian companies of all sizes to keep pace with the new technological explosion that is taking place all over the world.

Invention is another key factor in making Canada more competitive and more productive. To encourage innovation, we want to be able to invite people or companies with new ideas to develop them in complete secrecy at ORF. All of the expertise and facilities required for evaluation, design, process engineering, prototypes, testing, and small-scale production are under one roof at Ontario Research. We also have several pilot plants that could be used to prove out a variety of new processes.

In the future, we would hope to extend this "Incubator Program" for technological innovation to include start-up production facilities that might support initial marketing activities. This could lead to the establishment of a Technology Park program which would shelter new enterprises until they were proven profitable and ready to advance to larger quarters.

We hope that much of our new thinking will prove to be highly valuable to small and medium-sized plants, since almost 90% of Canada's industry falls within this category. It is this group that will ultimately have the greatest positive effect on both productivity and employment levels in our country. Yet, most small and medium-sized companies cannot afford to acquire the means of researching, improving and testing out new technologies. This leaves the broad-scale facilities and know-how of ORF with a vitally important role to play on their behalf.

For example, in our continuing close working relationship with the Ontario government, we are endeavouring to tie in with a stated objective of the Ministry of Industry and Trade to obtain more world product mandates for branches of multinational companies located in Ontario. Since many of these branches may not have the facilities to set up test runs for new processes or production lines, Ontario Research can offer valuable assistance in supporting their negotiations with home office. We intend to make a strong presentation of our wide-ranging capabilities to this group of Ontario companies.
We appreciate the assistance of the Ministry of Industry and Trade and welcome all opportunities to link ORF to their stated technology priorities. It is just such linkages which will help to integrate Ontario's emerging technical base.

In general, ORF long-range planning will be very proactive in meeting the new, critical needs of older industries, and will address the needs of emerging information industries as well. Although many aspects of the ideas outlined in this message are still in the formative stages, the Executive Committee of the Board of Governors supports the overall direction of this type of planning. I want to thank them and the Board of Governors for their strong encouragement, and for the active part our Board Members are beginning to take in support of major programs.

In the coming years, we not only hope to see greater use of in-place facilities at ORF, we also want to extend acceptance of our many services.

For example, Ontario Research is a world-class technology information centre. Smaller companies in particular can derive immense, low-cost benefits from our enormous technical library and our computerized literature and patent searches. Any company that is serious about competing in world markets – or about meeting foreign prices and quality in domestic markets – must have up-to-date information concerning new methods, materials and applications. We can provide in-depth surveys of the current techniques employed in any field, anywhere in the world, within a few days. Very often, just reading the detailed up-dates we can supply will enable a small producer to become a more effective competitor. This, combined with the fact that we can help to develop economical adaptations of new techniques for businesses of all sizes, must be emphasized in our future messages to the industrial marketplace.

To broaden our services to industry, ORF must also increase its own pool of skills. So we are taking a closer look at ourselves as we assess the current technological environment in the Province. How will we renew our R&D resources to aid the re-industrialization of Canada? What new training will we require? Which types of minds must we attract in the coming years? How will we encourage and develop a new cadre of management talent for ORF?

To find answers to such questions and to open more dialogue at all levels within ORF, we have formed a Committee on Human Resources. This special group, headed by Dr. David Henderson, should provide management with many new avenues to explore in 1984.

I must say that I am singularly impressed by the calibre of the people at ORF. There are no owners of ivory towers here. In fact, I have never met a more lively or more practical technology group – nor one that is so willing to put in the extra hours of effort so often required by our occupation.

This is very reassuring – because Ontario Research now faces the most crucial decade of its long history... and we are determined to find and apply the ideas that will make Ontario and Canada world-class producers once again.

W. Paul Midghall

W. Paul Midghall

Energy

Improving energy utilization and conservation will be key issues in our economy for many years to come. In 1983, Ontario Research performed vital R&D in this area – on projects ranging from heat pumps and grain dryers to the successful development of alternate fuels for internal combustion engines.

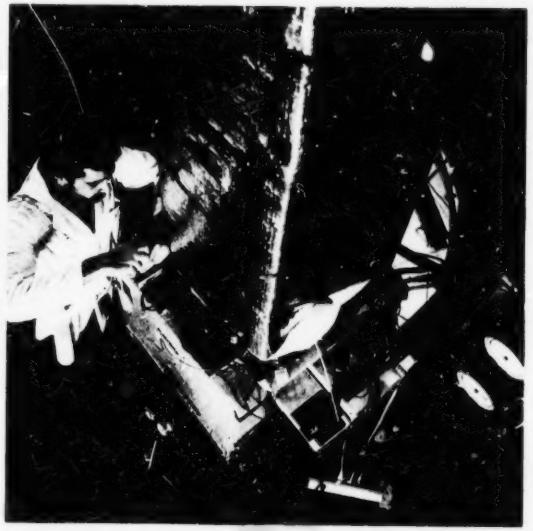
ENERGY CONSERVATION

In August, ORF assumed total technical and administrative responsibility for the Provincial government's mobile Energy Bus program on behalf of the Ministry of Industry and Trade. This program offers free energy audits and conservation advice to industrial, commercial and institutional establishments. The Energy Bus is equipped with an on-board mini-computer, video displays, demonstration equipment and energy measuring devices. It is operated by technical personnel specializing in energy conservation.

Since assuming responsibility for the Energy Bus program, ORF has added two more energy consultants to meet the Ministry's expanded energy conservation service objectives. These consultants, with the aid of portable microcomputers, are available to provide an essentially similar service to smaller companies whose energy consumption is not sufficient to warrant a visit by the Energy Bus.

Our work on behalf of the federal department of Energy, Mines and Resources in the National Building Energy Technology Transfer (BETT) Program continued during 1983. Under this program, ORF has been designated as a national lead agency responsible for the transfer of energy conservation technology and its implementation in high-rise commercial and high-medium rise residential buildings.

On behalf of Agriculture Canada, an energy efficient grain drying system was designed and retrofitted in a commercial operation of 100,000 bushel / hour capacity. Operation of this design, which incorporates an optimized heat recovery system, was field monitored during the 1983 drying season. Full details of the performance of the new grain drying system and a comparison with conventional systems will be published during 1984.



We also continued work on behalf of Agriculture Canada by field monitoring a new generation greenhouse system which was developed and built during 1981/82.

Preliminary analyses of the first year of monitoring indicates that the new generation greenhouse system makes a significant contribution to energy conservation. Crop quality from the new generation greenhouse was equivalent to that produced in conventional greenhouses. An improvement in productivity was also observed.

The field monitoring project will continue for another two years.

Work continued on developing, manufacturing and testing prototype hardware and controls for improving the energy efficiency of VIA Rail Canada's passenger cars. Following the current laboratory simulation and evaluation program undertaken at ORF, the new steam heating system will be retrofitted to an existing passenger coach and evaluated in the National Research Council's cold chamber facility in Ottawa prior to field installation and monitoring.

During 1983, with assistance from the Provincial Grant, ORF commissioned new facilities dedicated to R&D in heat pumps and air-to-air heat exchangers. These technologies play a vital role in energy conservation. ORF's new facilities are considered state-of-the-art in North America.

Prototype wall systems, innovatively designed for energy conservation, were evaluated in the recently commissioned Guarded Hot Box. The wall systems evaluated included concrete block and steel constructions, with cellular polystyrene or polyurethane insulation. The manufacturers were able to select the most promising features for future development from the results we obtained.

SOLAR ENERGY SYSTEMS

A substantial further step was taken in the development of practical test methods and equipment to evaluate Solar Domestic Hot Water Systems on behalf of the National

Opposite page, left to right:
ORF assumed total control of the Provincial Energy Bus Program.
Ed Thomas works in the newly commissioned ORF Heat Pump Facility.

This page, left to right:
Rob Caron works on a Perkins engine in one of the ORF test cells.
Newly-commissioned guarded hot box explained to visitor by Greg Hildebrand.

Research Council. A further phase of this project will be undertaken during 1984.

In the Passive Solar Technology area, a project was commissioned on behalf of the National Research Council. It deals with optimum integration of conventional space heating systems and passive solar systems in multi-storey buildings.

ALTERNATE FUELS

The activities of our Centre for Alternate Fuel Utilization (CAFU) were mainly focussed on alternative transportation fuels, diesel emission control, and fuel conservation projects.

Work with alternative transportation fuels is still a major activity, despite a current over-supply of conventional crude oil products. In addition to the continuing need to develop alternative and renewable energy sources in this field, a significant surplus of methanol production capacity in Canada has greatly increased interest in the development of methanol fuels.

As a result of proposed regulations on the lead content of Canadian gasoline, there is new interest in the near-term use of methanol/gasoline fuel blends. A project for Celanese Canada Inc., funded jointly with the Ontario Ministry of Energy and Energy, Mines and Resources Canada, was completed, on an automotive fleet test using a 4.75 per cent methanol/gasoline blend with isobutanol as cosolvent. Fuel performance, driveability and cold weather starting were found to be satisfactory and comparable to those of vehicles operated on regular unleaded gasoline. No differences were observed in materials compatibility and wear characteristics of the test fuel vehicles and the control cars.

A study for the Canadian General Standards Board (CGSB) is reviewing the effects of methanol blends on fuel system components – in order to develop appropriate materials standards.

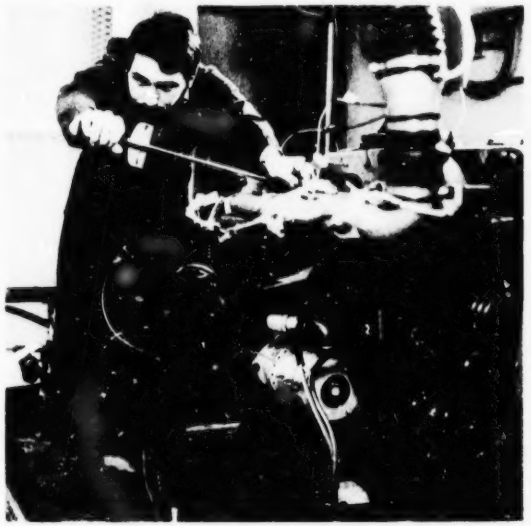
In another program for Transport Canada, a number of different, 100% methanol-fuelled passenger cars were tested for cold-start capability. Development of improved cold starting technology, involving fuel primers and secondary fuels, is now in progress at ORF – in co-operation with Ford Motor Company, General Motors Corporation, and Volkswagen A.G.

A program for INCO Limited on the partial substitution of methanol in underground diesel engines is nearing completion. A parallel study for the Ontario Ministry of Transportation and Communications examined the feasibility of developing 100 percent methanol-fuelled engines for underground operations. An assessment of methanol fuel utilization options is also being carried out for the Ontario Energy Corporation as part of their Methanol Assessment Program.

Work on ethanol and vegetable oil fuels was continued for Agriculture Canada. Much of this project has become a co-operative venture between ORF and Perkins Engines Limited, England.

ORF has undertaken dynamometer testing of propane-specific engines for Chrysler Canada Ltd. We also began development of a heavy duty propane engine for Class 8 trucks. This project, supported by the Ontario Ministry of Transportation and Communications and the Ministry of Energy, is a co-operative program between ORF and Cummins Gas Engines, Texas.

Hydrogen remains of interest as a longer-term fuel option. We completed a feasibility study to show that hydrogen generated from methanol could be used to fuel an internal combustion engine. A further major phase of this work is being negotiated with the National Research Council.



Environment

Every industrial society pays a price for progress in terms of pollutants and unwanted waste materials. Most ORF research concerning the environment is aimed at restoring the purity of our air and water, both in the home and the workplace. Other key projects are focussed on finding beneficial uses for wastes. One of our ongoing commitments in this area is coast-to-coast operation of the Canadian Waste Materials Exchange.

AIR

Emissions of toxic organic substances from a variety of sources are important environmental concerns in North America. Two major emission measurement projects were completed during the year. These were undertaken to determine the levels of dioxins and related organics released from the incineration of municipal garbage, and from a cement kiln burning liquid industrial waste as a fuel supplement. Results were being compiled at year end.

In addition to a variety of smaller emission measurement and compliance studies, ORF undertook extensive studies of emissions from the new Tricil liquid industrial waste incinerator in Sarnia and from the Edmonton refinery of Texaco Canada.

Ultimately, emissions affect ambient air quality. In 1983, ORF continued to operate the Sarnia air monitoring program for the Lambton Industrial Society, along with complementary programs for individual local companies. The Lambton Industrial Meteorological Alert (LIMA) system for predicting periods of adverse atmospheric dispersion has proved to be effective. In addition to such monitoring programs, ORF has conducted air quality impact assessments for the Ontario Waste Management Corporation in conjunction with their site selection project for industrial waste management facilities.

WATER

Water quality can be influenced at many points from the source to the tap. For a number of companies, ORF provides on-going analytical monitoring of influent water and of effluents from treatment processes. Of particular current interest is an assessment of aqueous effluents from new energy conversion technologies and their possible re-use.

Microbial corrosion of the interior walls of water distribution mains, which causes "rusty" water, has been investigated for an Ontario municipality. Grant funds were used to develop the techniques necessary to study this widespread problem.

Sponsored by the United States Environmental Protection Agency, ORF carried out a study of turbidity and how it relates to asbestos fibre concentrations in water. In this study, a balanced bridge photometer was modified to allow fibre-specific readings to be obtained from drinking water samples. The detection level of this fibre measurement technique was improved by the development and incorporation of several selective preconcentration procedures.

OCCUPATIONAL AND ENVIRONMENTAL HEALTH

Inert tracer gases have been used successfully to assess potential work-place hazards associated with inadequate ventilation. Such tracer gas studies were conducted for VIA Rail Canada to identify the extent to which locomotive engine exhaust emissions might enter the air intake vents of trailing passenger cars.

Also, in conjunction with the full-scale burn tests of an LRC coach for VIA Rail, the products of combustion were monitored to ascertain the types and concentrations of toxic substances which might be formed.

Another major project utilizing tracer gases determined the effectiveness of a ventilation system for removing methane gas from the face of a 7.6 meter diameter tunnel boring machine, one of the largest machines of its kind in Canada.

A research agreement between the Ontario Ministry of Labour, CANMET, and the U.S. Bureau of Mines, resulted in further collaborative projects during 1983 to develop improved emission control technology for underground

Opposite page, left to right:
Stack sampling, conducted by Jim Craigmile is an early step in emission studies.
A new approach to sanitary landfill practice was assessed.

This page, left to right:
Dr. John Christison examines microbial corrosion of municipal water distribution mains.
Paul Gerroir studies asbestos on scanning electron microscope.

mines. Technology breakthroughs occurred during 1983 when two techniques were developed, which showed that trap autoregeneration could be achieved during computer simulated mines duty cycles carried out on a computer-controlled engine test bed. The use of fuel additives showed great promise in this regard, and the development of catalyzed particulate trap technology, in conjunction with Engelhard Corporation, also showed effective autoregeneration capability. Further studies are in progress to define in detail the emission benefits.

These findings enhance the practicality of commercial operation with such emission control systems, which offer the possibility of savings in mine ventilation costs, and improving the health and safety of the underground workers. With further development, these units are expected to be commercially available by 1985.

During 1983, short studies were made for many clients to determine the presence of asbestos in building insulation. Measurements of airborne asbestos fibre concentrations were also made in general purpose buildings, subway systems and mine atmospheres.

The high cost of evaluating air samples for asbestos content by electron microscopy has created interest in developing less expensive measurement techniques. Health and Welfare Canada has supported a continuing ORF program in this area, based on two novel approaches to the problem.

Two major reports on asbestos fibre measurement were prepared for the Royal Commission on Matters of Health and Safety Arising from the Use of Asbestos in Ontario. These reports have been published, and additional consultation services were also provided to the Royal Commission.

WASTE TREATMENT

ORF provides services to its clients in each of the "4R's" of waste abatement: reduction, re-use, recovery and recycle. To encourage such practices, sound information is required to determine their technical and economic feasibility. A multi-volume manual detailing such information for the textiles, chemical, primary metal, electroplating, and food industries was completed for Resource Integration Systems Ltd. in 1983.

For the Federal Government, a code of good practice for the management of hazardous wastes from institutional laboratories was developed. The Federal Government also partially supports our on-going operation of the Canadian Waste Materials Exchange. We recently made recommendations to Ottawa that would increase the effectiveness of the Exchange.

The first commercial Wetox unit for organic waste destruction and energy recovery was successfully brought on stream at Uniroyal Chemical in 1983.

Among re-use projects, the utilization of products from the wet combustion of lignin residues or swine manure in the hydrolysis of corn stover to fermentable sugars showed encouraging potential. A new approach to sanitary landfill practice, which results in more rapid land settlement and greater generation of useable methane gas, was assessed. Both technical and economic aspects were included in this assessment.

ANALYTICAL SUPPORT

ORF applies a broad range of sophisticated analytical facilities in trace contaminant studies. Metals, pesticides, PCB's and other organics at the parts-per-trillion levels are routinely determined by this equipment – in substrates ranging from air and water samples to animal tissues and soils. Our special capability in the Ames mutagenicity assay also continues to be in demand. We use these facilities in the study of engine emissions, leachates from landfill sites, and in other areas.

Materials

Additives and coatings, novel applications of temperature or pressure, and scores of other factors which can improve or change the qualities of a substance, are indicative of but a few activities in this area. From advanced ceramics and crystalline metals to pottery and prosthetics, "materials" covers a very broad range at ORF.

BUILDING MATERIALS

In a project carried out for Watts, Griffis and McOuat, a range of raw materials was evaluated for a proposed 1.2 million tons per year Portland cement plant in Malaysia.

We also provided assistance to United Asbestos Inc. in assessing the radiation attenuation properties of concrete containing fine and coarse aggregates of serpentine ore.

Under the auspices of the National Research Council Solar Thermal Energy Program, a project was established to examine the feasibility of micro-encapsulating phase change chemicals in plastic matrices to form passive solar storage construction materials.

Seal durability as well as thermal and sound attenuation qualities of insulated sealed glazing units were evaluated for different combinations of seal materials and a number of glazings. ORF carried out this work for the Ontario Ministry of Municipal Affairs and Housing funded by the Ontario Ministry of Energy, under the Housing Energy Management Program (HEMP).

The Speakman Centre for Materials Evaluation continued to assist manufacturers of building products to meet the requirements of the CMHC Building Materials Evaluation Report program. The customary list of materials (flooring, roofing and insulation) was expanded in 1983 to include larger assemblies of materials such as windows and weatherstripping seals. New apparatus to determine amounts of air and water leakage for windows and doors is expected to contribute to the growth of this area in 1984.

SPECIALTY MATERIALS

In the area of glass and ceramics materials, CHROMALITE™, a new high capacity heat storage material developed for Chromalox Canada, is now undergoing field trials.

We also studied the feasibility of using Canadian instead of imported raw materials in the refractory stucco compositions used in investment casting moulds. This work was done for the National Research Council.

In addition, we assisted Designed Precision Castings Inc. in developing ceramic investment casting mould materials requiring lower firing temperatures than those employed with current mould materials.

On behalf of NRC, we undertook the development of a novel hydrogen-storage system based on glass microcapsules. The project has progressed through the initial concept feasibility stage to the investigation of the long-term behaviour, performance limits, and costs of the system.

In another energy-related program, our client, Blue Mountain Pottery, supported the development of boron nitride felt battery separators for lithium-aluminum/iron sulphide batteries.

The National Research Council sponsored a continued ORF study of the structure and properties of lead-based ceramic glazes, a subject of considerable interest to the Canadian earthenware industry. New oven-to-table ware with properties superior to those of their current product, was the subject of one of our investigations funded by Blue Mountain Pottery. The same company supported the development of decorative ceramic giftware that can be produced in one firing cycle.

Blue Mountain Pottery has been using ORF for R&D support since 1968. This year, the company decided to move into advanced ceramics and formed a new division, BM Hi-Tech Inc. The initial project, undertaken with the assistance of Ontario Research, is the development of advanced electronic ceramics for piezo-electric devices.

Literature reviews of structural high performance ceramics such as silicon nitride, silicon carbide and partially-stabilized zirconia, for diesel engine applications, was

Opposite page, left to right:
Boron nitride felt battery separators developed in Vince Curtis' lab.
Richard Lederle places burning cigarettes to check ignition in upholstery.

This page:
Doug Renton evaluates raw materials for a Malaysian Portland cement plant.

undertaken for Defence Research Establishment Ottawa (DREO). In the case of the partially-stabilized zirconia, experiments were carried out.

Another advanced material is silica aerogel. It exhibits the characteristics of a dense gas rather than a solid and has potential applications as a thermal insulator for windows and as a substrate for vapour phase catalysts. We investigated development of this material on behalf of the National Research Council.

The feasibility of applying heat-reflective, highly transparent coatings to glass, using Sol-gel technology, was studied for the National Research Council. Energy, Mines & Resources sponsored a project involving the use of spray pyrolysis technology in the production of abrasion-resistant coatings to protect softer substrate materials.

We also investigated the protection of graphite moulds (used in the non-ferrous foundry industry) with chemical vapour deposition coatings. This was done on behalf of Canadian Alloy Castings.

Two programs relating to the utilization of waste materials were sponsored by Energy, Mines and Resources. The development of abrasion resistant glassceramics from blast furnace slags continued. This program is of interest to the building and mining industries. Also, a study of the glassy nature of fly ashes, slags and silica fume was initiated, in view of the potential utilization of these materials in high performance concretes.

In a project carried out for NRC, a method was developed for evaluating the abrasive qualities of fillers used in plastics.

BIOMATERIALS

Our work on vascular grafts continued. A prospectus offering ORF's technology for licence was prepared and distributed. As a result, several companies expressed interest and a licensing agreement is being negotiated.

Potential clinical and commercial advantages in applying a porous metal coating to the bonding surface of orthodontic brackets, were further demonstrated in an investigation we carried out on behalf of Augusta Developments.

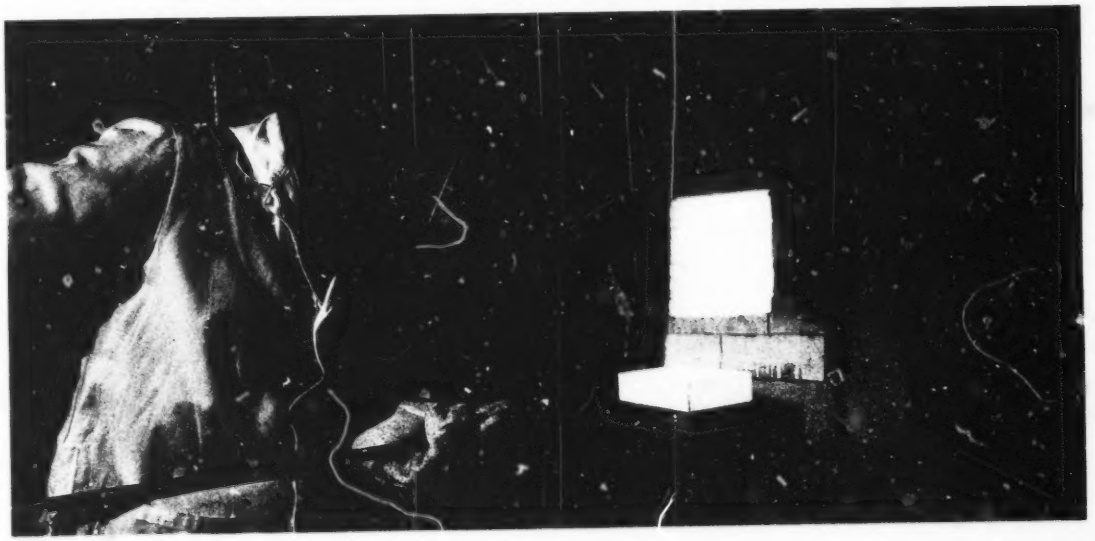
Over several years, ORF has developed a finger joint prosthesis for the treatment of hands severely affected by arthritis or trauma. The device consists of surgical stainless steel and ultrahigh molecular weight polyethylene components which articulate and provide joint resurfacing. Recently, ORF manufactured a series of prototypes in co-operation with a major orthopaedic products manufacturer. These are to be used in a clinical study at the Orthopaedic and Arthritic Hospital. To date, several sets have been successfully implanted in patients.

METALS

Rapid Solidification Technology (RST), in which unusual or enhanced properties are imparted to alloys by quenching them from the molten state at rates in excess of 10,000°K per second, is of considerable interest worldwide. The Defence Research Establishment, Atlantic, sponsored a program to investigate the effects of RST on aluminum alloys. Copper alloys were the subject of another RST program undertaken on behalf of CMP Metal Powders. In both instances, RS ribbon was produced by melt spinning. The potential of these RST products was demonstrated by mechanical testing and metallography.

Powder Metallurgy (P/M) Technology, which is closely allied to RST, was the subject of two programs. One, funded by Sinteris Canada Inc., was concerned with stainless steel P/M. The other, supported by Canadian Stackpole Ltd., dealt with more-conventional ferrous alloys.

Other metal studies by Ontario Research included the fracture resistance of Canadian steels likely to be used in Arctic and offshore construction. This program was of interest to Energy, Mines and Resources Canada. The spring characteristics of stainless bellows used in nuclear power plants were determined for United Flexible of Canada Ltd. We also made a comparison study of the properties of thermite-welded joints in rails on behalf of the Toronto Transit Commission.



10 Materials Cont'd.

This page, left to right
Greg Hildebrand uses new apparatus to determine water leakage for windows
John Cerar with Rapid Solidification Technology (RST) samples.

Opposite page, left to right
Steve Strong with railroad car transponder analysed for E.I.D. Systems.
Kay Matsumura studies caramel colours.

FIRE AND FLAMMABILITY

The assessment of fire hazard in rail car interiors was continued on behalf of VIA Rail Canada. Test results have confirmed the importance of full scale testing oi an actual rail car interior, over and above material sample testing, in order to more accurately predict a response of railway vehicle interiors to a fire hazard. This has brought about design modifications which have further improved passenger safety by reducing flame spread and products of combustion.

The burning characteristics of cigarettes in relation to their propensity for causing ignition in mattresses was investigated on behalf of the Department of Consumer and Corporate Affairs. Seven cigarettes purported to be "self-extinguishing" and twenty regular brands of cigarettes were included in the study. The burn temperatures, burn rates, and time to ignite mattresses were determined. Work is continuing to determine the effects of burning characteristics of cigarettes on their propensity to ignite upholstered furniture. Work is also underway to evaluate possible flammability test methods for upholstered furniture.

Products and Processes

Many Ontario industries, especially those in the small to medium size range, do not have the skills or the facilities to identify and research all of the factors involved in new product development. By supplying all-encompassing R&D on a project basis, Ontario Research offers these companies a way to keep their output competitive – even in fast-moving world markets. Several of the projects covered in our "Products and Processes" category could be used to illustrate this point.

PULP, PAPER & WOOD

In the forest products area, a variety of new product and process development studies, product quality audits, and in-plant consultation assignments were carried out for Dominion Cellulose.

We also made an analysis of water and oil-borne preservatives used in wooden utility poles. And we have applied for patents relating to improved absorbency of sanitary napkins.

TEXTILES

Protective apparel is an expanding area. In this field, uses are found for new fabrics and processes almost as soon as they emerge.

In response to enquiries from both government and industry, our Textiles and Clothing Technology Centre has developed expertise in several areas of protective wear. These include cold weather garments and sleeping bags (which we test with our Manikin Extreme Weather Apparel Comparator), and firefighting apparel (tested for heat and flame resistance, insulative values and durability). We have also made preparations to evaluate such gear in terms of comfort as well as protection. Apart from elements that may constrict the wearer, the measurement of comfort also involves such parameters as the body's production of water vapour and how easily it will pass through the fabric.

During the year, considerable use was made of our test facility which determines the electric shock resistance of footwear, particularly occupational types. The equipment was designed at Ontario Hydro and our Footwear Laboratory developed testing methods which led to important modifications. The Canadian Standards Association has now agreed to accept ORF results from this equipment for their certification of footwear in regard to electric shock resistance.

MICROELECTRONICS

During 1983, ORF continued solar energy related test and instrumentation development. For example, a computer controlled system was developed for the semi-automatic testing of solar domestic hot water heating systems. This system is now in use by the National Solar Test Facility (NSTF). Research was also done on developing test methods for the use of the NSTF solar simulator in determining the performance of photovoltaic panels. This work has been extended and a computer controlled system for the routine testing of photovoltaic panels is now under development for the NSTF.

An updated version of the self-contained computerized test systems designed for the NSTF for testing air type thermal solar collectors was completed and delivered to the National Research Council in Ottawa. This system was displayed in operation during the NRC open house this spring. As a result, a number of overseas countries are now interested in acquiring similar testing systems from ORF.

ORF continued to develop instruments for on-site solar systems. We made design improvements to a microprocessor-based energy meter which will allow continuous real time computation and display of the system's performance compared to how the system should perform under the current collection conditions. This feature will allow system operators to make corrections to the system in time to recapture potential lost energy.

PRODUCT DESIGN & EVALUATION

Various approaches to encapsulating tantalum capacitors were investigated for Sprague Electric of Canada. The final concept, which appears to be commercially feasible,

allows for the manufacture of encapsulated capacitors with a relatively high volumetric efficiency.

With our new Heat Pump R&D facility, ORF is assisting a major Canadian manufacturer in the development of a new generation of pumps, specially designed for the Canadian climate. R&D support was also provided for a number of manufacturers of air-to-air heat exchangers. Both of these industries are experiencing a rapid growth and require advanced R&D support facilities.

In this area, ORF also handled a major project for the National Research Council. We investigated the economics of an air to water heat pump for retrofitting existing residences with hydronic space heating systems.

Drilling fluids – or muds – are essential for below-ground exploration. Technifluids of Calgary, Canada's leading supplier of these products, wanted far more information about downhole mud performance than existing test equipment could supply. In May of 1981, Technifluids asked Ontario Research Foundation for assistance in designing and developing the means of acquiring reliable data, especially for extreme operating conditions. The company specified that accurate mud evaluations were to be made at pressures up to 140,000 kPA (about 20,000 psi) and at temperatures up to 343°C (650°F).

ORF have now conceived four different pieces of equipment whose combined use will provide Technifluids with more comprehensive downhole mud data than any other company can offer. These four units are: a viscometer, a fluid loss tester, a stickometer, and a mud density meter. Construction of the viscometer and fluid loss tester began in March 1983 and neared completion at year's end.

Technifluids also commissioned ORF to design a third system which would simulate and measure the soil-mechanics properties of "mud cake". This cake is deposited on the walls of bore holes by the drilling fluid. It is needed to seal the side walls during the drilling of oil, gas or thermal wells in order to prevent loss of the drilling fluid through permeation.

These three systems will extend Technifluids' laboratory capability and will allow their staff to assess all the significant properties of various drilling fluids under simulated down-hole conditions. ORF's design work has resulted in the filing of four international patent applications, all of which have been assigned to Technifluids.

STRESS ANALYSIS AND EQUIPMENT TESTING

The development of a software computer program has been undertaken for the Defence Research Establishment, Quebec. The objective is to predict the stress and strain levels in mechanical structures which have been subjected to high energy, short duration pressure pulses caused by explosions. The finite element method of stress analysis is the technique being used in the program. Initial results are encouraging and further development work is anticipated.

The cost benefits of using such an analytical tool over that of experimentation are substantial.

Ontario Research conducted experimental analysis on the elbow joint section of Spar Aerospace Limited's manipulator arm. The actual stress levels and deflections caused by various predetermined load conditions were monitored and recorded. These experimental results were used by Spar to check their analytical results derived from finite element analysis.

We designed, assembled, calibrated, and commissioned an instrumentation system for Bell Aerospace. The system is used to measure several parameters of an Air Cushion Equipment Transporter whose purpose is to transport fighter aircraft over rough terrain. Cushion pressure, engine operating conditions, loads, and acceleration levels of both the transporter and aircraft are monitored by this system.

Simulated environmental conditions were applied to test a railroad car identification system designed by E.I.D. Systems of Montreal.

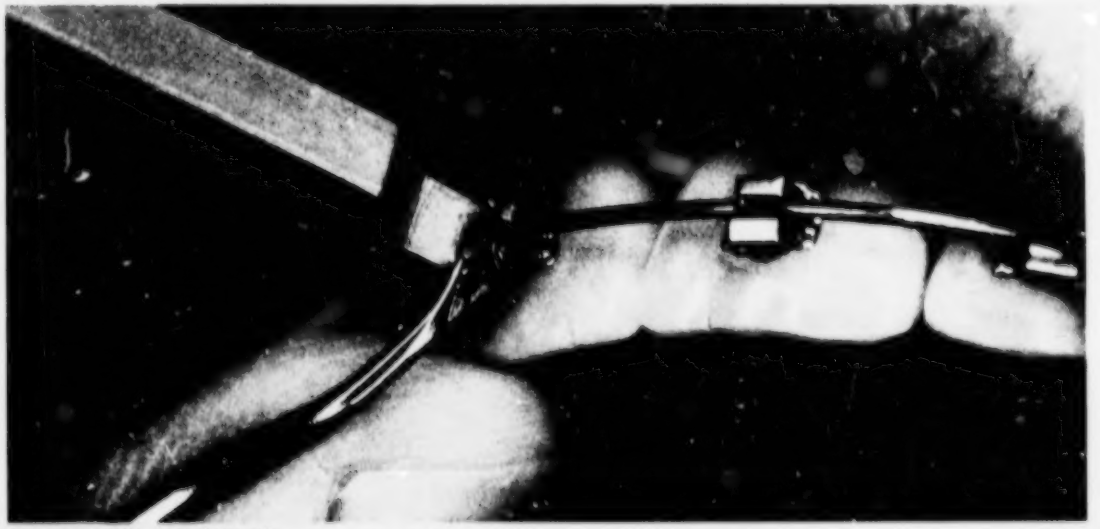


Photo courtesy of Augusta Developments Inc.

Opposite page:
Improvements to orthodontic brackets were investigated during the year.

This page, left to right:
Greg Wallace adjusts newly-designed machine which assembles party hats.
John Purse of ORF (left) and Tim Conn of Technifluids examine fluid loss tester design.

The system is a self-contained, battery operated micro-electronic package mounted on the side or underside of a railway car.

This transponder is designed for remote communication of car identity and contents to wayside electronic devices under all weather and track conditions normally encountered.

Shock, impact, temperature and vibration tests were carried out on a sufficiently large number of these devices, in accordance with American railroad and military standards. The results of the tests will help to evaluate the life expectancy of the system before a commitment to high volume production is made.

We carried out seismic qualification tests for Atomic Energy of Canada Limited on electrical cable penetration assemblies used in nuclear power installations. These tests employed a hydraulically operated vibration table and an electronically controlled servo-system.

An instrumentation testing program was undertaken on behalf of the Instrument Testing Service Inc. to evaluate total residual chlorine analysers for on-line use in water and waste water treatment facilities.

PACKAGING TECHNOLOGY

In response to increasing national and international regulation of dangerous goods packaging, ORF undertook a study of packaging performance levels and requirements on behalf of Transport Canada. We developed test protocols which were able to determine the ability of various types of dangerous commodity packaging to withstand the rigours of distribution and delivery. Selected steel and plastic drums and pails, corrugated container systems, and infectious substance packages were evaluated by employing experimental techniques.

Magic Pantry Foods Inc. and Agriculture Canada commissioned ORF to develop a method of non-destructively testing flexible food pouch seals at production speeds. The food pouches are made of a laminate consisting of three layers – polypropylene, aluminum foil and polyester.

During the filling and sealing process, faults such as wrinkles, particulate inclusions and delaminations occasionally occur in the seal area of the food pouch. This currently necessitates an expensive visual examination of every pouch. A system is being developed to automatically inspect the seal using ultrasound wave energy modulated by an optical laser system. This technique will allow more reliable and cost effective detection of possible seal imperfections. Work on this project is continuing.

PRODUCTIVITY

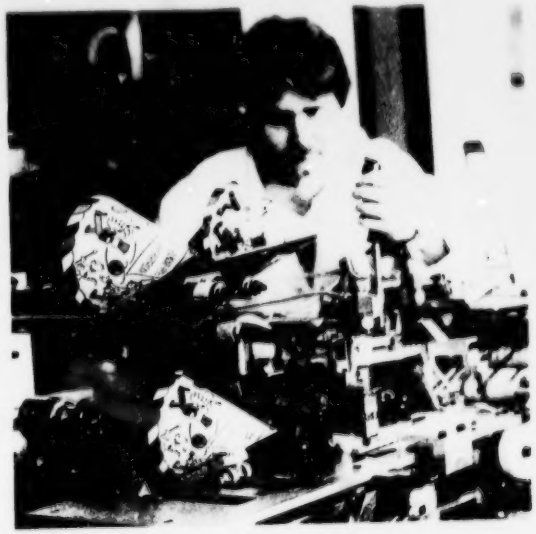
During 1983, our Industrial & Management Services Group maintained its active participation in productivity enhancement projects on behalf of client companies through the accomplishment of several productivity studies. These were conducted in secondary manufacturing industries, primarily associated with hardware, automotive parts and proprietary products.

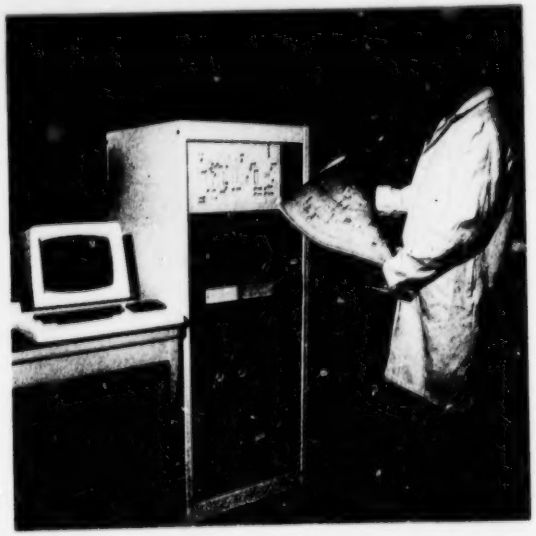
Our continuing seminar program series on Essential Skills in Production Management and Product Development was expanded to include a new offering on Productivity Improvement. A total of eleven, one, two and three-day seminars were delivered during the year. Further topics are under development to supplement this ongoing program in 1984. These include, Creative Product and Process Design for Cost Reduction, Mini-Computers for the Small Businessman, and Statistical Process Control.

Product Development Workshops were held in six cities in northern Ontario and in five southwestern Ontario centres. In-house training programs relating to the Application of Office Standards and Value Engineering were also developed by our staff.

A "Productivity Newsletter" was published quarterly in 1983 and we plan to continue it on that basis in 1984.

ORF directly assisted the Ontario Centre for Automotive Parts Technology during its start-up phase.





14 Products & Processes Cont'd.

A major portion of our IMS Group activity continued to be the field delivery of the Industrial Research Assistance Program as sponsored by the National Research Council. This no-charge service was expanded during the latter part of 1983. Field offices are now established in Willowdale, Kitchener and St. Catharines. Over 2,000 clients were serviced in the past year. This included the placement of 33 students in client companies on approved projects, under the direction of Field Advisors.

FOOD & PHARMACEUTICALS

For the fifth consecutive year, work in the comprehensive characterization of caramel colours, their homogenity and classification, has continued for the International Technical Caramel Association.

Other active areas of food process and product development included shelf life testing, nutritional analysis, and the re-utilization of surplus dairy products.

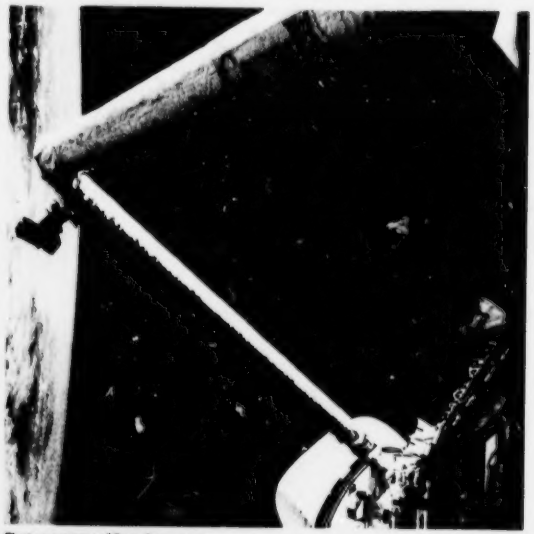


Photo courtesy of Spar Aerospace.

This page:

Elbow joint of Spar Aerospace manipulator arm underwent experimental analysis.

Opposite page, left to right:

Peat analyses in a Senegal laboratory.

Greg Murawsky helps to process asbestos from Alaska drill core samples in the ORF Pilot Plant.

Resources

During 1983, minerals and fuels were major areas of activity for ORF in the "Resources" category. Since a great deal of our country's wealth is derived from its resources, we must maintain strong R&D capability in this area. The increased number of projects we handled for this sector in 1983 indicates a recovery in an important part of our economy.

MINERAL PROCESSING

In collaboration with Watts, Griffis & McOuat Limited, work continued on a program to recover and evaluate asbestos from drill cores extracted from a major ore body in Alaska. This program, which originated in 1978, is sponsored through Watts, Griffis and McOuat by a consortium consisting of GCO Minerals Company, a subsidiary of International Paper Company and Tanana Inc., a subsidiary of Doyon, Limited, an Alaska Native Regional Corporation.

As in the past, various methods have been evaluated to determine the maximum fibre recovery possible from small drill core samples of the ore and to produce marketable grades of asbestos. During 1983, this work was extended to include the evaluation of fibre quality and recovery from large (12-inch diameter) drill core samples using a larger scale processing line.

An investigation was conducted on behalf of Energy, Mines & Resources Canada, to assess the energy savings resulting from the application of a wet chemical comminution process to recover asbestos fibre from asbestos ore. Comparisons were made on a small pilot scale between conventional dry processing and new wet chemical techniques.

At bench-scale levels, ORF established the process parameters for the SMDC Uranium project. This development will exploit the high grade uranium deposits at two locations in Saskatchewan. The flowsheet included grinding, leaching, liquid-solid separation, solvent extraction, and waste management.

A project we started for Borealis Exploration Ltd. in 1983 is aimed at establishing parameters for exploiting large reserves of high-grade magnetite located in the North West Territories. This company intends to produce a high grade magnetic concentrate using various magnetic separation procedures.

Our work for the Orrwell Energy Corporation has shown that a high grade flaked graphite product can be produced from a Quebec ore body grading 10% graphite. A plant is being built based on the ORF flowsheet and the results we obtained. It will be the first plant of this type to produce purity graphite products.

In a project for Copconda, we explored the feasibility of extracting a saleable grade graphite from an Ontario deposit.

Crushing and grinding projects were conducted for Industrial Garnet Ltd. to determine the best equipment for processing the desired product. Crushing and grinding was also conducted for Union Carbide Canada Ltd., with tonnage quantities of materials processed to produce marketable products.

We also completed an in-depth study for a U.S. client to determine the presence and identity of mineral fibres in a source of vermiculite.

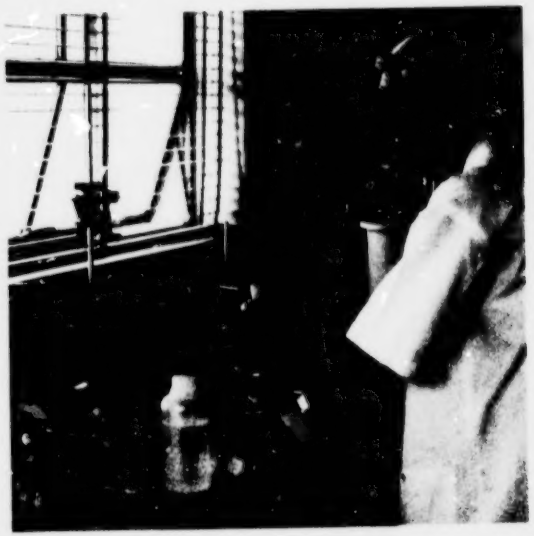
PROCESS METALLURGY

In 1983, ORF conducted several processing studies of ore samples by hydrometallurgical techniques. These were carried out for Iron Ore Company of Canada (manganese), Norton Research Company (abrasive), Interox America (uranium), and USARCO (copper).

Processing of ore samples by both pyro and hydrometallurgical techniques were conducted for Tantalum Mining Corporation.

A project for Acres Davy McKee Engineering Inc., investigated the technical and economic feasibility of extracting gold from complex ores employing techniques developed by ORF.

Melting and atomizing of stainless steel was carried out for Breed Corporation, and special metallic coatings were developed and tested for Homeshield Industries Ltd.



16 Resources Cont'd.

This page, left to right.
Don Hebert loads a 12-inch research cupola with carbon briquettes.
An automated filter press is operated by Aldo Marascio in ORF Pilot Plant.

FUEL RESOURCES

A novel alternative to distillation for the recovery of biomass-derived liquid fuels is being developed by Ontario Research, on behalf of the National Research Council.

Grant funds were used to examine processes for obtaining usable feeds, fuels and chemicals from various agricultural wastes.

In the OEC-Monenco (Ontario) Ltd. project, we conducted studies to identify gasification process options for producing methanol from wood and peat resources located in Ontario.

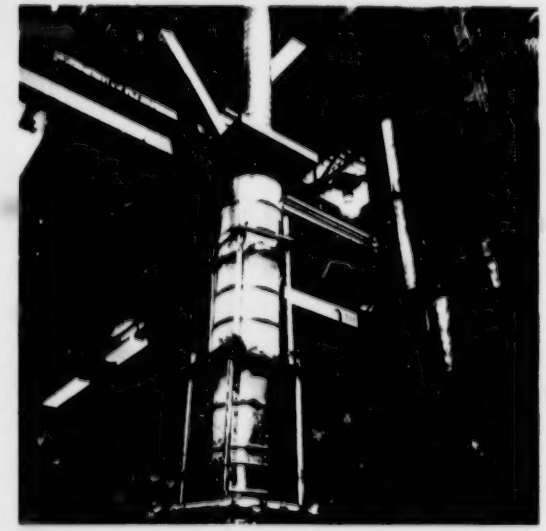
Peat is the only large-scale indigenous fossil fuel in Ontario. At year end, a number of ORF projects were underway to facilitate the de-watering and processing of this resource and to create marketable products from it.

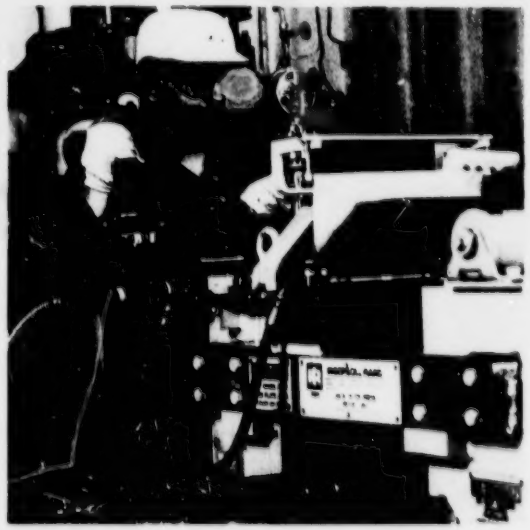
In collaboration with La Société d'Ingenierie Cartier Ltée and with La Compagnie des Tourbières du Senegal, who were both supported by the International Development Research Centre, ORF designed and installed a laboratory for peat analyses in the Republic of Senegal and trained local staff. This was followed by work on beneficiation of the peat material in ORF's Pilot Plant. Senegal is seeking to develop its peat resources to replace oil imports.

To assist in determining economic uses for residual pitches from hydrocracking processes, a detailed analytical protocol for their chemical characterization was developed.

Conversion of a high grade manganese ore to a manganese alloy employing a pilot-scale shaft furnace using coal as the sole source of fuel, was demonstrated for Iron Ore Company of Canada. Low grade coal is used as fuel and reductant for metallization to demonstrate the technical and economic feasibility of this process.

A project for EMR-Kilborn concerned the installation and commissioning of a coal liquefaction pilot plant aimed at producing liquid fuels and chemicals from Canadian coals. This system is well suited to determine the grade and yield of liquid fuels and chemicals that can be obtained from coal, bitumen, and biomass of various origins. Reactor throughput is up to 1 kg of solids per hour at residence times ranging from 5 to 15 seconds.





WASTE UTILIZATION

On behalf of the Environmental Protection Service of Environment Canada, we conducted an investigation into the technical and economic feasibility of utilizing by-product gypsum formed by flue gas desulphurization processes. Comparisons were made between natural and other by-product gypsums for commercial applications. An assessment of disposal technology was also completed.

ORF continued to provide project evaluation and management for the Ontario Ministry of the Environment's program on the processing of solid waste and its conversion to energy.

Grant funds were used to develop new processes. One is for the production of fuel alcohol by fermentation. Another concerns the collection of hydrogen from organic wastes for use as a fuel. Investigations are also underway to discover an economic means of coupling low-BTU gasifier output to a modified diesel engine.

Board Members & Officers

BOARD OF GOVERNORS

Chairman

***D.A. Chisholm**
Executive Vice-President
Technology and Innovation
Northern Telecom Ltd.

Vice-Chairmen

***J.S. Dewar**
Corporate Director

***D.M. Green**
Chairman and Chief Executive Officer
The Tridon Companies

Members

H.T. Beck
President
Noma Industries Ltd.

T.J. Bell
Chairman of the Board
Abitibi-Price Inc.

A.S. Cartwright
Chairman and Chief Executive Officer
Canadian General Electric Co.

R.M. Dillon
Alafin Consultants

J. Warren Flanagan
Corporate Director

J.M. Ham
Corporate Director

A.J. Harris
Corporate Director

R.F. Hawkins
Representing the Canadian Manufacturers' Association
Vice-President and General Manager
Union Drawn Steel Company Ltd.

Members Cont'd.

H. Hofmann
President
Devtek Corporation

J.D. Houlding
President
Polar Gas Project

J.W. Kerr
Consultant and Director
TransCanada PipeLines Ltd.

***James W. MacLaren**
Consulting Engineer

W. Posluns
President
Dylex Limited

R.D. Radford
Vice President and Treasurer
The Canada Life Assurance Co.

G. Sinclair
Chairman
Sinclair Radio Laboratories Ltd.

***W. Steven**
Corporate Director

W.C. Winegard
Chairman
Ontario Centre for Farm Machinery & Food Processing Technology

*Member of Executive Committee and of Audit Committee

CORPORATE OFFICERS

D.A. Chisholm
Chairman

J.S. Dewar
Vice Chairman

D.M. Green
Vice Chairman

W.P. Midghall
President

J.N. Matthews
Vice President,
Corporate Facilities and Secretary

B.T. Porter
Vice President,
Finance and Treasurer

INVESTMENT COMMITTEE

R.D. Radford
Chairman

D.A. Chisholm,
Member (ex officio)

D.C. Dique
Member

W.P. Midghall
Member (ex officio)

B.T. Porter
Secretary

NOMINATIONS COMMITTEE

J.S. Dewar
Chairman

R.M. Dillon
Member

J.M. Ham
Member

W.P. Midghall
Member

J.N. Matthews
Member

Financial Statements

AUDITORS' REPORT

To the Board of Governors of
Ontario Research Foundation

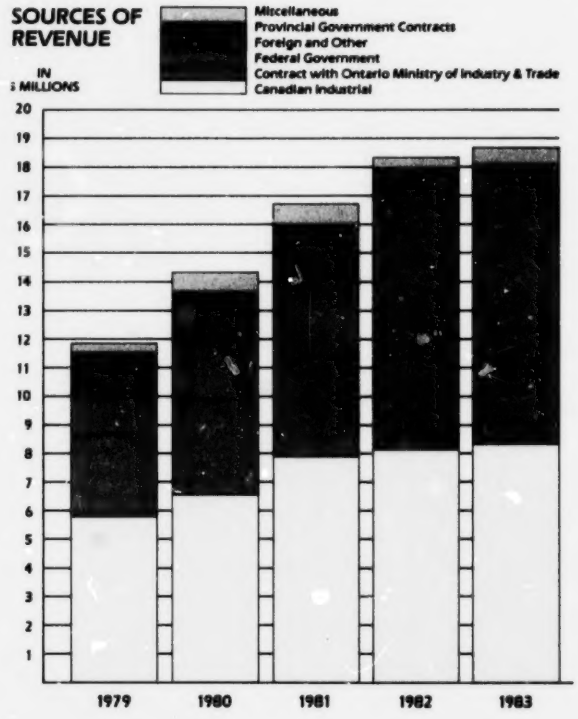
We have examined the consolidated balance sheet of Ontario Research Foundation as at December 31, 1983 and the consolidated statements of fixed asset contributions, appropriated surplus, income and unappropriated surplus and changes in financial position for the year then ended. Our examination was made in accordance with generally accepted auditing standards and accordingly included such tests and other procedures as we considered necessary in the circumstances.

In our opinion these consolidated financial statements present fairly the financial position of Ontario Research Foundation as at December 31, 1983 and the results of its operations and the changes in its financial position for the year then ended in accordance with generally accepted accounting principles applied, after giving retroactive effect to the changes in accounting for fixed asset contributions and net gains on the sale of investments, the reclassification of capital surplus and the appropriation of surplus for the replacement and expansion of the physical plant as explained in note 1F to the financial statements, on a basis consistent with that of the preceding year.

Toronto, Canada
March 9, 1984

Allen Miles Fox & Johnston

ALLEN, MILES, FOX & JOHNSTON
Chartered Accountants

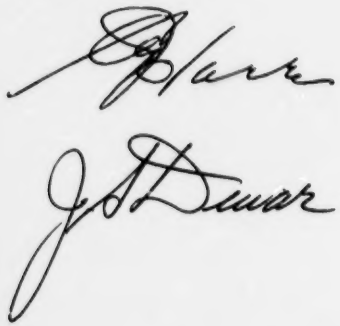


CONSOLIDATED BALANCE SHEET

as at December 31, 1983

	1983	1982
ASSETS		
Current Assets		
Short-term deposits	$ 1,029,562	$ 1,083,190
Accounts receivable	3,611,520	3,347,907
Accrued interest receivable	11,081	16,022
Inventory of stores	104,808	80,939
Prepaid expenses	177,960	83,089
	4,934,931	4,611,947
Investments (note 2)	1,214,694	1,359,665
Fixed Assets (note 3)	14,178,785	14,435,966
	$20,328,410	$20,407,578
LIABILITIES		
Current Liabilities		
Bank indebtedness	$ 114,017	$ 18,597
Accounts payable and accrued liabilities	1,138,448	1,054,670
Amounts received in advance for research and other projects	225,154	289,483
Current portion of long-term debt (note 4)	—	240,000
	1,477,619	1,602,750
Long-Term Debt (note 4)	—	360,000
	1,477,619	1,962,750
CAPITAL		
Capital Contributions	3,363,100	3,363,100
Fixed Asset Contributions	6,228,903	6,328,296
Appropriated Surplus	9,250,000	8,750,000
Unappropriated Surplus	8,788	3,432
	18,850,791	18,444,828
	$20,328,410	$20,407,578

Approved on behalf of
the Board of Governors



CONSOLIDATED STATEMENT OF FIXED ASSET CONTRIBUTIONS

for the year ended December 31, 1983

	1983	1982
Fixed asset contributions, beginning of year	$6,328,296	$6,672,040
Fixed asset contributions received from the Province of Ontario (note 5)	612,000	361,000
	6,940,296	7,033,040
Transfer to income	711,393	704,744
Fixed asset contributions, end of year	$6,228,903	$6,328,296

CONSOLIDATED STATEMENT OF APPROPRIATED SURPLUS

for the year ended December 31, 1983

Appropriated surplus, beginning of year		
As previously reported	$ 375,000	$ 375,000
Prior period adjustment (note 1F)	8,375,000	7,965,000
As restated	8,750,000	8,340,000
Appropriation for replacement and expansion of physical plant	500,000	410,000
Appropriated surplus, end of year	$9,250,000	$8,750,000
Surplus has been appropriated for:		
Replacement and expansion of physical plant	$8,875,000	$8,375,000
Anticipated improvements to the Improved Retirement Plan on March 1, 1985	375,000	375,000
	$9,250,000	$8,750,000

CONSOLIDATED STATEMENT OF INCOME AND UNAPPROPRIATED SURPLUS

for the year ended December 31, 1983

	1983	1982
REVENUE		
Professional services	$14,118,777	$13,719,324
Performance grant from the Province of Ontario (note 5)	3,987,000	4,347,500
Investment income	216,206	279,933
Other	415,691	135,284
	18,737,674	18,482,041
EXPENSE		
Salaries	10,414,966	10,290,652
Employees' pension and other benefits	822,540	754,483
Other direct project costs	4,041,812	3,903,313
General	1,940,938	1,978,888
Depreciation	1,723,455	1,842,110
	18,943,711	18,769,446
Loss from operations	206,037	287,405
Transfer from fixed asset contributions (note 1F)	711,393	704,744
Income for the year	505,356	417,339
Unappropriated surplus (deficit), beginning of year		
As previously reported	(945,205)	(622,504)
Prior period adjustments (note 1F)	948,637	618,597
As restated	3,432	(3,907)
Unappropriated surplus before appropriations	508,788	413,432
Appropriation for replacement and expansion of physical plant	500,000	410,000
Unappropriated surplus, end of year	$ 8,788	$ 3,432

CONSOLIDATED STATEMENT OF CHANGES IN FINANCIAL POSITION

for the year ended December 31, 1983

	1983	1982
Source of working capital		
Operations		
Income for the year	$ 505,356	$ 417,339
Items which do not affect working capital		
Net gain on sale of investments	—	(35,296)
Loss on disposal of equipment under capital lease	—	101,296
Depreciation	1,723,455	1,842,110
Transfer from fixed asset contributions (note 1F)	(711,393)	(704,744)
	1,517,418	1,620,705
Net decrease in investments	144,971	423,392
Fixed asset contributions (note 5)	612,000	361,000
Proceeds of sale of equipment under capital lease	—	180,000
	2,274,389	2,585,097
Use of working capital		
Cost of construction	276,819	194,833
Acquisition of apparatus and instruments (net)	954,762	716,484
Acquisition of other fixed assets (net)	234,693	121,773
Reduction of obligation under capital leases	—	341,720
Reduction of long-term portion of bank loan	360,000	400,000
	1,826,274	1,774,810
Increase in working capital	448,115	810,287
Working capital, beginning of year	3,009,197	2,198,910
Working capital, end of year	$3,457,312	$3,009,197

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS

December 31, 1983

1. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

A. Principles of Consolidation
These consolidated financial statements include the accounts of Ontario Research Foundation and its wholly-owned subsidiary, Ordco Technology Limited.

B. Inventory of Stores
Inventory of stores is valued at the lower of cost and replacement cost.

C. Fixed Assets and Depreciation
Fixed assets are stated at cost. Depreciation is provided on a straight line basis at the following annual rates:

Buildings	3-1/3% and 5%
Equipment	6-2/3%, 10%, 15% and 20%
Automotive equipment	33-1/3%

D. Capital Contributions
Capital contributions comprise the original capital sums donated by the Province of Ontario and industry, the income from which is being used to assist in meeting annual expenses in accordance with the terms of the contributions.

E. Method of Computing Professional Services Revenue
Professional services revenue is recognized on the basis of the percentage of completion of the work at estimated fees earned or at per diem billing rates depending upon the contractual arrangements.

F. Changes in Accounting Policies
As of January 1, 1983, Ontario Research Foundation changed its policies with respect to accounting for fixed asset contributions received from the Province of Ontario and industry and for the net gain on the sale of investments. Under the policy adopted in 1983, fixed asset contributions are included in capital and are transferred to income on a straight line basis at the annual rates referred to in note 1C. Net gains realized on the sale of investments are reflected as revenue in the statement of income.

Coincidental with these changes, capital surplus, representing gains realized on real property and reserves appropriated from surplus in prior years, has been reclassified as unappropriated surplus and a transfer has been made to surplus appropriated for the replacement and expansion of the physical plant.

This restatement of capital funds has had no effect on the cash flow of Ontario Research Foundation.

The effect of these changes, which have been applied retroactively, is as follows:

	Total at Jan. 1/82	Increase in income for the year ended Dec. 31/82	Increase (decrease) in unappropriated surplus at Jan. 1/82	Increase in appropriated surplus at Jan. 1/82
Fixed asset contributions	$5,167,405	$704,744	$4,462,661	$ —
Net gain on investments	1,675,856	35,296	1,640,560	—
Capital surplus	2,480,376	—	2,480,376	—
Physical plant appropriation	—	—	(7,965,000)	7,965,000
	$9,323,637	$740,040	$ 618,597	$7,965,000

2. INVESTMENTS

	1983	1982
Bonds, at amortized cost		
Government, direct and guaranteed	$ 396,409	$ 491,317
Public utility	99,963	101,032
Industrial and other	23,000	77,995
Common stocks, at cost	695,322	689,321
	$1,214,694	$1,359,665
Quoted market value	$1,911,456	$1,772,527

3. FIXED ASSETS

	1983			1982
	Cost	Accumulated Depreciation	Net	Net
Land	$ 597,438	$ —	$ 597,438	$ 597,438
Buildings	12,303,122	4,418,964	7,884,158	8,082,634
Equipment	14,620,200	8,941,048	5,679,152	5,734,885
Automotive equipment	99,708	81,671	18,037	21,009
	$27,620,468	$13,441,683	$14,178,785	$14,435,966

4. LONG-TERM DEBT

	1983	1982
Bank loan, bearing interest at the rate of 1/8% below the prime rate without specific terms for principal repayment.	$ —	$600,000
Less estimate of the portion to be repaid within the following year included in current liabilities	—	240,000
	$ —	$360,000

5. GRANTS FROM THE PROVINCE OF ONTARIO

In 1983, Ontario Research Foundation received from the Province of Ontario grants totalling $4,599,000 of which $3,987,000 has been allocated to income and $612,000 to fixed asset contributions.

6. CONTINGENT LIABILITIES

A. A claim in the amount of $50,000,000 has been made against Ontario Research Foundation and eight other defendants alleging unlawful conspiracy among the defendants.

B. A claim for damages alleging negligence in approving the safe use of urea formaldehyde has been made against Ontario Research Foundation and thirteen other defendants.

C. Two claims regarding employment terminations have been made against Ontario Research Foundation.

Ontario Research Foundation is disputing these claims and has instructed its solicitors to defend its position. The extent of the losses, if any, and the legal fees associated with these claims cannot be estimated at this time.

1983 Papers

This page:
Over 20 technical papers, presented by ORF staff, were published during 1983.

1170 **Pullan, H.** **Harrison, S.** **Albach, G.**
The Solar Simulator at the Canadian National Solar Test Facility. Proceedings of the Workshop on Solar Simulators, European Commission and the International Energy Agency, Ispra, Italy, 70-74, February 1982.

1171 **Lakshmanan, V.I.** **Fraser, K.S.** **Mells, L.A.**
The Midwest Uranium Project – Development of the Milling Process. CIM Bulletin, April, 113-123, 1983.

1172 **Brandstatter, H.G.**
Extraction of Chromium from Low-Grade Canadian Sources. Energy, Mines and Resources Canada, CANMET Division Report MRP.MSL 83-101(OP), R1-R40, July 1983.

1173 **Vergeer, H.C.** **Burnett, T.C.** **Goetz, W.A.** **McGarvey, P.**
Methanol Fuel Extending Technologies Applied to DI and IDI Diesel Engines. Proceedings of the Alternative Fuels Contractors' Coordination Meeting Workshop, Windsor, Ontario. 120-124, September 1983.

1174 **Lawson, A.**
Propane, Methanol, Biomass and Hydrogen Fuel Utilization Program. Proceedings of the Alternative Fuels Contractors' Coordination Meeting Workshop, Windsor, Ontario. 125-165, September 1983.

1175 **Lakshmanan, V.I.** **Ashbrook, A.W.**
Uranium Purification. 799-804, Handbook of Solvent Extraction, John Wiley & Sons Inc. 1983.

1176 **Chatfield, E.J.**
Methods of Fibre Measurement in Ambient Air. Proceedings of the International Conference on Fibrous Dusts, Strasbourg, France, VDI-Berichte Nr. 475, 33-63, 1983.

1177 **Chatfield, E.J.**
Measurement of Asbestos Fibre Concentrations in Ambient Atmospheres. Royal Commission on Matters of Health and Safety Arising from the Use of Asbestos in Ontario. Study No. 10, May 1983.

1178 **Johar, S.** **Murthy, M.K.** **Fahr, A.** **Sturrock, W.R.**
Detection of Surface Flaws in High Performance Ceramics by Surface Acoustic Wave Technique. Advanced NDE Technology, Proceedings of a Conference sponsored by Industrial Materials Research Institute, NRCC, 15-20, May-June 1982, Montreal, Canada.

1179 **Leidner, J.** **MacGregor, D.C.** **Wong, E.W.C.** **Wilson, G.J.**
A Novel Process for the Manufacturing of Porous Grafts: Process Description and Product Evaluation. Journal of Biomedical Materials Research, 17, No. 2, 229-247, 1983.

1180 **Leidner, J.**
Plastics Waste Recovery of Economic Value. Proceedings of the Division of Polymer Chemistry, American Chemical Society Meeting, Washington, D.C. 24, No. 2, 425-426, 1983.

1181 **Luckevich, L.M.**
Marketability of FGD Gypsum By-Product. Proceedings of Seminar on Flue Gas Desulphurization. Canadian Electrical Association, 2-11, September, 1983.

1182 **Laughlin, R.G.W.** **Robey, H.L.** **Gallo, T.**
Wet Air Oxidation for Hazardous Waste Control. Journal of Hazardous Materials, 8, 1-9, 1983.

1183 **Robey, H.L.**
Cyanide Destruction in a Commercial-Scale Hydrolysis Reactor. Plating and Surface Finishing, 70, No. 6, 79-82, 1983.

1184 **Tobin, R.S.** **Horton, A.** **Smith, D.K.** **Armstrong, V.C.**
Methods for Testing the Efficacy of Ultraviolet Light Disinfection Devices for Drinking Water. AWWA Journal, 75, 481-484, 1983.

1185 **Smith, D.K.** **Brown, W.D.**
Review of Materials in Contact with Potable Water and Tests for Evaluation for Unsuspected Health Hazards. Health & Welfare Canada Report 83-EHD-93, 1983.

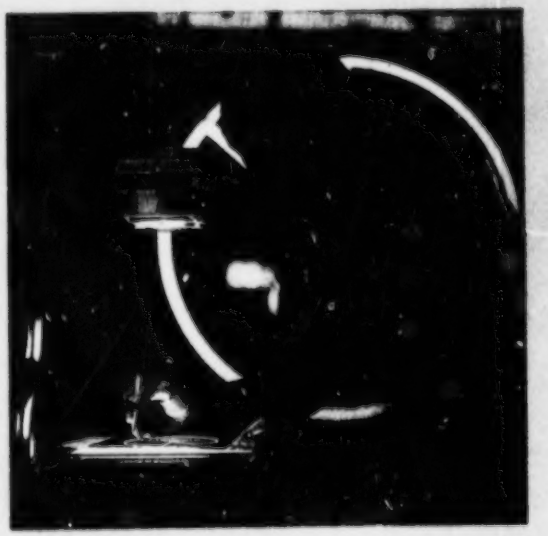
1186 **Peakall, D.B.** **et al** **Reynolds, L.M.**
Determination of the DDE and PCB Contents of Peregrine Falcon Eggs: A Comparison of Whole Egg Measurements and Estimates Derived from Eggshell Membranes. Archives of Environmental Contamination and Toxicology, 12, 523-528, 1983.

1187 **Busby, D.G.** **et al** **Reynolds, L.M.**
Effect of an Organophosphorus Insecticide on Brain Cholinesterase Activity in White-Throated Sparrows Exposed to Aerial Forest Spraying. Journal of Applied Ecology, 20, 255-263, 1983.

1188 **Das, B.S.**
Applications of HPLC to the Analysis of Polycyclic Aromatic Hydrocarbons in Environmental Samples. Liquid Chromatography in Environmental Analysis, 2, 19-75, 1983.

1189 **Athey, J.A.B.**
Testing Soft Body Armour, RCMP Gazette, 45, No. 11 1-4, 1983.

1190 **Wilson, A.G.** **Hunter Dunn, R.**
The National Building Code of Canada: Its Production, Interpretation and Revision. Proceedings of the Third Canadian Building Congress, National Research Council of Canada, No. 21158, 127-132, 1982.



Some of our clients

A.E.C.L.
Acres Davy McKee Engineering Inc.
Agriculture Canada
Augusta Developments Inc.

Bell Aerospace
Blue Mountain Pottery
Borealis Exploration Ltd.
Breed Corporation

CMP Metal Powders Inc.
Canadian Alloy Castings
Canadian General Standards Board
Canadian Stackpole Limited
Canadian Standards Association
Canviro Consultants Ltd.
Cartier Engineering Ltd.
Celanese Canada Inc.
Chromalox Canada Inc.
Chrysler Canada Limited

Defence Research Establishment, Ottawa
Defence Research Establishment, Atlantic
Defence Research Establishment, Quebec
Department of Consumer & Corporate Affairs
Designed Precision Castings Inc.
Dominion Cellulose

E.I.D. Systems Ltd.
Energy, Mines & Resources Canada
Engelhard Corporation
Environment Canada

Health & Welfare Canada
Homeshield Industries Ltd.

INCO Limited
Industrial Garnet Ltd.
International Technical Caramel Association
Interox America
Iron Ore Company of Canada

Kilborn Engineering

Lambton Industrial Society

Magic Pantry Foods Inc.
Ministry of Industry & Trade

National Research Council
Norton Research Company

Ontario Energy Corporation
Ontario Ministry of Energy
Ontario Ministry of Labour
Ontario Ministry of Municipal Affairs & Housing
Ontario Ministry of Transportation & Communications
Ontario Ministry of the Environment
Ontario Waste Management Corporation
Orrwell Energy Corporation

Resource Integration Systems Limited

SMDC Uranium
Sinteris Canada Inc.
Spar Aerospace Limited

Sprague Electric of Canada

Tantalum Mining Corporation
Technifluids
Texaco Canada
The Royal Commission on Matters of Health & Safety Arising from the Use of Asbestos in Ontario
Toronto Transit Commission
Transport Canada
Tricil
Trow Limited

U.S. Bureau of Mines
U.S. Environmental Protection Agency
USARCO
Union Carbide Canada Limited
Uniroyal Chemical Inc.
United Asbestos Inc.
United Flexible of Canada Ltd.

VIA Rail Canada

Watts Griffis & McOuat Ltd.

This page:
ORF staff meet with Technifluids management team.

Opposite page:
ORF's Matthew McKim, member of the Chemical Advisory Committee at Sheridan College.

Back cover, left to right:
Jim Larocque in the microelectronics lab.
Greg Winterhelt checks one of the solar test drivers.
Cathe Tyrrell in the Asbestos Laboratory.

Assistance to outside organizations

More than 50 staff members of Ontario Research served on various boards and committees of the following organizations during 1983:

Air Pollution Control Association
American Association of Textile Chemists and Colorists
American Powder Metallurgy Institute
American Society of Brewing Chemists
American Society of Heating, Refrigeration and Airconditioning Engineers
American Society for Testing and Materials
Association of Official Analytical Chemists
Association of Professional Engineers of Ontario
Association of Provincial Research Organizations

Board of Trade of Metropolitan Toronto

Canada/Commission of European Communities
Canada Association of Textile Colourists and Chemists
Canadian Carpet Institute
Canadian Ceramic Society
Canadian General Standards Board
Canadian Geotechnical Society
Canadian Institute of Mining and Metallurgy
Canadian Manufacturers' Association
Canadian Nuclear Society
Canadian Pulp and Paper Research Committee
Canadian Research Management Association
Canadian Society for Industrial Engineering
Canadian Society for Professional Engineers
Canadian Standards Association
Canadian Uranium Products
Chemical Institute of Canada
Construction Safety Association of Ontario
Council on Protective Equipment

Electrochemical Society (Ontario/Quebec Section)
Eurogypsum-Working Community of the European Gypsum Industry

George Brown College of Applied Arts and Technology

Health and Welfare Canada

Institute of Textile Science
Institution of Production Engineers
International Confederation for Thermal Analysis
International Mineralogical Association
International Organization for Standardization
International Society for Industrial and Hazardous Waste

Journal of Thermal Analysis

National Fire Protection Association
National Research Council of Canada
National Sanitation Foundation
Natural Sciences and Engineering Research Council of Canada (NSERC)

Occupational Hygiene Association of Ontario
Ontario Association of Certified Engineering Technicians and Technologists
Organization for Economic Cooperation and Development

Pollution Probe

Réunion Internationale des Laboratoires d'Essais et de Recherches sur les Matériaux et les Constructions (RILEM)
Royal Commission on Asbestos

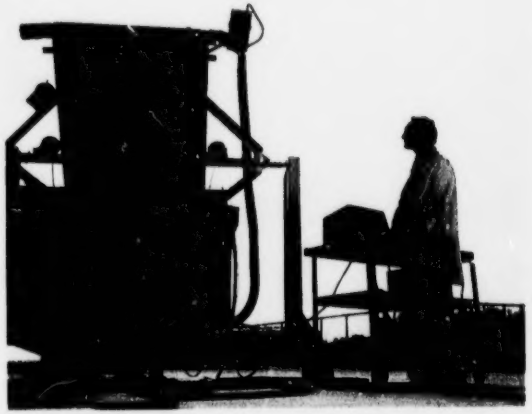
SATRA-North America Research Inc.
Sheridan College of Applied Arts and Technology
Sheridan Park Association
Society of Research Administrators Canada
Source Evaluation Society

Technical Association of the Pulp and Paper Industry
Textile Society of Canada
Textile Technical Federation of Canada
Thermal Analysis Abstracts

Underwriters' Laboratories of Canada
University of Toronto, Faculty of Forestry

ONTARIO**RESEARCH**
FOUNDATION

SHERIDAN PARK RESEARCH COMMUNITY
MISSISSAUGA, ONTARIO, CANADA L5K 1B3
TEL. (416) 822-4111 TELEX: 06-982311
ISSN 0078-5083



Printed in Canada

POOR

QUALITY

ORIGINAL